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following birds have been found to eat ticks; those eating Texas-fever ticks are: Killdeer (*Oxyechus vociferus*), Upland Plover (*Bartramia longicauda*), and Meadowlark (*Sturnella magna*); net ticks (*Dermacentor occidentalis*): Dwarf Hermit Thrush (*Hylocichla guttata nana*); castor-bean ticks (*Ixodes* sp.): Boat-tailed Grackle (*Megaquiscalus major*), Meadowlark, and House Wren (*Troglodytes aëdon*); and *Gamasus* sp.: the Wren-tit (*Chamæa fasciata*).—W. L. McA.

Economic Ornithology in recent Entomological Publications.—

The greater prominence given to bird enemies of insect pests in recent entomological publications is a source of gratification to bird lovers. Increased recognition of the services of birds is common to both State and Federal entomological organizations, and in recent bulletins of the U. S. Bureau of Entomology, in particular, comment on the relations of birds to the insects discussed is seldom lacking.

Four papers on cereal and forage insects issued by the Bureau of Entomology during the present year include notes on birds in the discussion of natural checks of the insects treated. Fourteen species of birds, which the Biological Survey has found to feed on the clover-root curculio (*Sitones hispidulus*) are listed in Mr. V. L. Wildermuth's bulletin¹ on that beetle, and the statement is made that "natural enemies, such as fungous disease and birds, have without a doubt contributed largely towards holding the insects in check."

The clover-root curculio belongs to a genus of beetles closely related in appearance and habits, which do a large amount of obscure damage, principally to clover. Few genera of beetles occur more frequently in bird stomachs than *Sitones*. Six species are known to be eaten and *Sitones* unidentified as to species have been found in the stomachs of 49 species of birds. On account of the present more complete indexing of Biological Survey records ten species can be added to the list of 14 Wildermuth gives as enemies of *S. hispidulus*. The complete list is: Upland Plover, Killdeer, Ruffed Grouse, Broad-winged Hawk, Flicker, Nighthawk, Chimney Swift, Wood Pewee, Crow Blackbird, Meadowlark, Lincoln Finch, Song Sparrow, Chipping Sparrow, White-throated Sparrow, Purple Martin, Barn, Tree and Bank Swallows, Northern Water-Thrush, Catbird, Chickadee, Hermit Thrush, Robin and Western Bluebird.

The English Sparrow comes in for condemnation along with an insect pest in an article² by W. Harper Dean on the sorghum midge (*Contarina sorghicola*). Both the bird and the insect curtail the number of sound mature seed produced, so that in parts of many sorghum-growing States a profitable crop cannot be secured. The work of the sparrow is much less important than that of the fly. Sorghum heads partly destroyed by

¹ Bull. 85, Part 3, Bur. Ent., March, 1910, p. 37.

² Bull. 85, Pt. 4, Bur. Ent., May, 1910, pp. 39-40.

both agencies are illustrated (fig. 20). On page 57 of the same publication it is stated that a hummingbird (probably *Trochilus alexandri*) was seen hovering about the heads of sorghum and to all appearances feeding on the midges.

Mr. C. N. Ainslie¹ comments on the natural enemies of the New Mexico range caterpillar (*Hemileuca olivæ*), a pest which has wrought steadily increasing damage for several years. Mr. Ainslie mentions seeing several Robins feeding on the caterpillars and adds (p. 95): "The importation of birds to feed on the caterpillars has been suggested, but in the infested regions the wide treeless plains afford but little encouragement for nesting birds. Besides this, it is a lamentable and criminal fact that in spite of laws that are designed for the protection of bird life in New Mexico, a constant and indiscriminate slaughter of all sorts of birds is in perpetual progress until the companionable species and those of high economic importance have been practically exterminated in many parts of the Territory. This condition of things may possibly account, in some measure, for this *Hemileuca* invasion, and may in the not remote future bring into prominence other insects now few and harmless, but multiplying because their bird foes have perished at the hands of hunters. This bids fair to become a serious matter, and not alone in New Mexico."

The store of information about bird food in the Biological Survey, the accumulation of 25 years of research, is again drawn upon for a list of the bird enemies of crane flies (Tipulidæ). The depredations of these insects range from local injuries in pastures and hayfields to the devastation of thousands of acres of grain crops and grass lands. Eighty-six species of birds are known to feed upon Tipulids and their eggs, showing a preference for these pests, that should be given substantial appreciation. "Among the birds which are known to feed upon the Tipulidæ, either as eggs, larvæ, or adults, probably the most important are the Wood Thrush (*Hylocichla mustelina*), the Alice Thrush (*Hylocichla aliciae*), the Catbird (*Dumetella carolinensis*), the Robin (*Planesticus migratorius*), and the Crow (*Corvus brachyrhynchos*). Of the total stomach contents of 22 specimens of the Wood Thrush, examined at the Illinois State Laboratory of Natural History, 12 per cent was made up of tipulid fragments, while 11 specimens of the Alice Thrush contained 8 per cent of tipulid fragments."² An important publication of the Bureau of Entomology deals with 'Plant Bugs Injurious to Cotton Bolls.'³ While no specific mention of bird enemies is made, space is given to a discussion of the prevalent idea that the offensive odor of bugs protects them from birds. "Without this supposition" the author says, "the object and origin of odoriferous glands may be difficult to explain, but studies in the feeding habits of

¹ Bull. 85, Pt. 5, Bur. Ent., June, 1910, pp. 93 and 95.

² Hyslop, James A. Bull. 85, Part 7, Oct. 1910, p. 129.

³ Morrill, A. W. Bull. 86, June, 1910.

insectivorous birds have shown that in most cases Pentatomid bugs are eaten at least to the extent of the proportion of their numbers to the numbers of other insects of the same and larger size. Further, it would seem that some birds, like the Crow, possess a predilection for insects of pungent or otherwise strong taste or odor. Careful studies have been made of the feeding habits of about 20 common American birds. Almost without exception Pentatomids (variously referred to as 'stink bugs,' 'soldier bugs,' and 'Pentatomids') are included in the diet of each of these birds, amounting on the average to about 3 per cent of all the food." The experience of the division of Economic Investigations of the Biological Survey is all to the effect that human criteria of taste can in no way be applied to birds. Failure in this respect has led to many fallacious statements concerning birds, one type of which relates to the bad taste of certain insects. None are more offensive to man than the stink bugs (Pentatomidæ). Nevertheless these insects are attacked by a great variety of birds and sometimes large numbers of them are consumed. Taking as a guide the amount of space occupied by cards in the Biological Survey food index, the Pentatomids are more relished by birds than any other family of Hemiptera and what is more surprising, than any family of Orthoptera which certainly rank as staple bird food. Dr. Morrill says: "Thus far no specific observations have been made for the purpose of determining the extent to which birds feed upon the conchuela [that is, *Pentatoma ligata*]. It is evident, however, that there is some important influence combined with egg parasitism to produce in midsummer the marked reduction in number of these insects observed both in Mexico and in Texas. The egg-parasites effectually check the multiplication of the pest after the month of July, but the diminution in numbers of the adults remains unexplained. In the laboratory, protected from their enemies, the life of the adult conchuela extends over many weeks, 27 specimens collected at Tlahualilo between July 6 and July 10 averaging over two months each.

"It is inconceivable that the difference between field and laboratory conditions should be so great that, of the insects of the field on July 10, over 60 per cent should die from natural causes before August 1, while in the laboratory less than 5 per cent should die during the same period. Furthermore, if the numerical decrease in question had been due to natural exhaustion of vitality of the adult insects, it would be expected that many dead specimens would have been found in the cotton fields. As a matter of fact, dead specimens were exceedingly rare and the few found gave evidence of having been destroyed by some enemy rather than of having died from natural causes. As has been shown, the decrease in numbers is a general and not a local occurrence, and it takes place without regard to the abundance of food. These circumstances seem to point to the strong probability that birds are the useful agents in the reduction of the numbers of the adults of the conchuela."

Another supposedly distasteful insect, the yellow-bear caterpillar (*Diacrisia virginica*), became injuriously abundant in the Upper Arkansas Valley, Colorado, in 1909. H. O. Marsh, who investigated the outbreak says:¹ "A remarkable feature of this outbreak is that the larvæ had so few natural enemies. Birds did not eat them, and with the exception of a few individuals which were killed by parasites and disease they appeared to be unmolested." It should not be inferred from this that birds never eat these very hairy caterpillars. As a matter of fact the Bobwhite² and the Black-billed Cuckoo³ are already recorded as feeding on them.

The Chief of the Bureau of Entomology, Dr. L. O. Howard, begins a new comprehensive series of publications on mosquitos with a bulletin entitled 'Preventive and Remedial Work against Mosquitos.' Ten pages are devoted to mosquito consumers such as salamanders, dragon-flies, predaceous mosquitos and fish. As this chapter discusses only the practical use of natural enemies of mosquitos, birds, not being susceptible to such use, are omitted. The fact that such a good general discussion of mosquito enemies other than birds is available, makes it desirable to give a hint at least of the number and kinds of birds that must be included in any complete survey of the natural enemies of mosquitos. In the report⁴ of the Chief of the Biological Survey for 1908 the Chimney Swift (*Chaetura pelagica*), Nighthawk (*Chordeiles virginianus*), Northern Phalarope (*Lobipes lobatus*) and Killdeer (*Oryechus vociferus*) are named as mosquito eating birds. Other Biological Survey records are for Wilson's Phalarope (*Steganopus tricolor*), Pectoral Sandpiper (*Pisobia maculata*), Baird Sandpiper (*Pisobia bairdi*), the Bank Swallow (*Riparia riparia*) and the Wren-tit (*Chamaea fasciata*). John B. Smith states⁵ that numbers of the larvæ of the salt marsh mosquito (*Aedes sollicitans*) were found in the stomachs of the Ring-neck Plover (*Ægialitis semipalmata*), the Least Sandpiper (*Pisobia minutilla*) and the Semipalmated Sandpiper (*Ereunetes pusillus*). In fact shorebirds in general seem to be especially fitted both by habits and tastes to be the most important enemies of mosquito larvæ among birds. Birds which feed on the wing naturally capture the most adult mosquitos. Such enemies include the Purple Martin (*Progne subis*),⁶ Cliff Swallow (*Petrochelidon lunifrons*),⁷ Bank Swallow (mentioned above), the Tree (*Iridoprocne bicolor*)⁴ and Barn Swallow (*Hirundo erythrogastra*)⁸ Chimney Swift, Whip-poor-will (*Antrostomus carolinensis*),⁹ and Nighthawk. Stomachs of the Cuban Nighthawk (*Chordeiles virginianus minor*)

¹ Bull. 82, Pt. 5, Bur. Ent., Aug., 1910, p. 62.

² Bull. 21, Biological Survey, 1905, p. 45.

³ Bull. 9, Biological Survey, 1898, p. 14.

⁴ Ann. Rep. Dept. Agr., 1908, p. 577.

⁵ Report on the Mosquitos of N. J., 1904, pp. 85-86.

⁶ Port Jefferson, N. Y. Echo, Aug. 17, 1901.

⁷ Merriam, F. A. Birds of Village and Field, 1898, p. 54.

⁸ Forbush, E. H. Useful Birds and Their Protection [1907], pp. 345-346.

⁹ Howard, L. O. Bull. 25, U. S. Div. Ent., 1900, p. 49.

examined by Allan H. Jennings on New Providence were distended with mosquitos.¹ The stomachs of a few warblers at the time were also full of mosquitos. Other birds recorded as consumers of mosquitos are Wood Pewee (*Myiochanes virens*), Phoebe (*Sayornis phæbe*), and Kingbird (*Tyrannus tyrannus*).²—W. L. McA.

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¹ Proc. Ent. Soc. Wash., X, 1908, p. 61–62.

² Forbush. loc. cit., pp. 232, 235 and 238.